

NOAA Response to:

A Review of NOAA's Satellite Program: a way forward

A report of the
Satellite Task Force (SATTF)
of the NOAA Science Advisory Board
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Introduction

NOAA appreciates the advice from the Science Advisory Board (SAB) in support of NOAA's satellite enterprise. Satellites comprise the largest segment of NOAA's investments in observing systems, providing volumes of Earth observation data that significantly influences NOAA's service quality. Resource allocation decisions for satellites have multi-decade significance because they include large engineering, procurement and launch costs plus years of application development and operations, including data acquisition, product processing and long-term stewardship. Optimizing NOAA's satellite enterprise may yield significant benefits to NOAA's environmental services, both from enhanced satellite data services and from an improved allocation of NOAA's long-term investments.

The SAB's Satellite Task Force (SATTF) reviewed NOAA's space system challenges and noted the daunting challenge of continuing the currently planned space systems within a limited and likely declining fiscal environment. Multi-day weather forecast models and short-term severe weather watches and warnings are vitally dependent upon massive volumes of timely data available only from satellites, including essential profiles of atmospheric temperature and moisture on a global scale and critical cloud imagery over the continental US and adjacent waters. This large dataset required by the National Weather Service (NWS) and other NOAA users, together with high space system costs and declining budget resources, motivated this review of NOAA's traditional satellite engineering and development approaches. This led the NOAA SAB SATTF to review and provide findings and recommendations to inform the way NOAA plans and acquires its satellite portfolio, to not only maintain continuity of providing critical observational data, but to address gaps in observational capabilities.

The time frame of the SATTF review was long-term, focusing on planning for next-generation space-based solutions. The existing major programs, the Joint Polar-orbiting Satellite System (JPSS) and the Geostationary Operational Environmental Satellite – R-Series (GOES-R) have motivated multiple expert reviews. Recent reviews have included the Department of Commerce Office of Inspector General (Report #OIG-12-038-A, dated September 27, 2012), the Government Accountability Office (GAO-12-604, dated June 2012) and the NOAA NESDIS Independent Review Team report dated July 20, 2012. These reviews were done independently and share some of the same concerns and observations reported by the SATTF.

The SATTF, through the SAB, provided an overview of NOAA's challenges, including a high-level examination of NOAA's satellite budget and potential gap risk in the afternoon polar-orbiting observatory. The report reviewed four fiscal and technical challenges, presented seven items as "Summary Findings and Observations" and reported eight "Summary Recommendations." The report also provided a number of "Specific Observations and Findings." This NOAA response will generally address the report findings and will specifically respond to the eight summary recommendations.

Fiscal and Technical Challenges

The fiscal and technical challenges facing NOAA's satellite service at the time of the SATTF review were quite significant. The SATTF report described four primary areas of challenge:

1. Increasing satellite system costs and uncertain fiscal environment
2. Maintaining satellite continuity
3. Balancing requirements push and technology pull
4. Sustaining Partnerships

First, NESDIS's fiscal environment is affected by the national challenges seen in the frequent use of continuing resolutions, budget sequestration and repeated battles over the debt ceiling. Achieving a stable and adequate funding stream for NOAA's satellite observing requirements continues to be a major priority and a major challenge.

Second, NOAA continues to be concerned about satellite continuity issues. Considerable study and planning has been done to mitigate a potential gap in the afternoon polar satellite orbit, which is described in more detail below. Other gaps in satellite data continuity across multiple instruments critical to supporting NOAA's operational requirements are also the subject of study and ongoing consultation with NASA and international partners.

Third, while NOAA has made great strides in more robustly understanding, documenting and validating observational requirements, the challenge of prioritization remains a work-in-progress. Because NOAA satellites support multiple mission needs, prioritization is especially difficult since individual observing platforms acquire multiple observations of varying criticality. Thus, satisfying the core observational requirement also usually satisfies lower priority requirements providing enhanced value to NOAA and decision-maker communities. Clearly, NOAA's prioritization challenge is a complex system optimization problem to find the set of achievable observational capabilities that are best aligned with NOAA's needs.

Fourth, international partnerships hold tremendous potential to aid observational continuity. However, many of NOAA's traditional worldwide partners are also facing difficult financial circumstances. So while NOAA and NOAA's partners have an increasing need to collaborate and share costs and responsibilities, the programmatic risks of all partners being able to achieve success in their individual roles remain high.

Findings and Observations

The SATTF provided seven "Summary Findings and Observations" and a number of "Specific Observations and Findings." A general comment is given below, followed by responses to specific recommendations.

Since its inception, NOAA's satellite observing systems have greatly increased in performance as well as in cost and complexity. A full development cycle from initial conception to full deployment takes over a decade and costs billions of dollars. While such large systems can offer some economies, they also present certain risks, including schedule risks, which are amplified when the budget planning cycle is volatile. The current era of budget volatility helped motivate NOAA's request to the SAB for advice. NOAA asked the SATTF to take a long-term perspective. Clearly, essential aspects of the plans for NOAA's satellites over most of the next two decades are set, with the major JPSS and GOES-R systems still in their prime early

operational and developmental phases. However, given the very long planning cycle for satellite systems, action is needed now to reposition NESDIS for a stronger future. In response, the SATTF suggested that NOAA take a new look at the approach to satellite systems development.

The SATTF challenged the sustainability of NESDIS' budget to meet currently planned space systems. Satellite systems are major long-term investments that do better in environments where multi-year planning can match provided resources and do not readily accommodate frequent budget re-planning. It can take up to a year to re-plan a major satellite acquisition program to match new budget assumptions. NESDIS, along with the rest of the federal community, has faced unprecedented volatility including numerous continuing resolutions, sequestration and potential gaps in appropriations. Thus, the challenge of frequent re-planning in the face of short-term funding volatility needs to be better understood.

The SATTF also pointed out that the fiscal environment could lead to increased risks and decreased scope for satellite services. This is clearly true as system implementation decisions must conform to constrained planning assumptions, and where cost and schedule constraints are critical parameters. This leaves technical performance as the system characteristic most at risk of degradation. Thus, the SATTF correctly recognized that NESDIS will be required to make programmatic trade-offs, impacting the quality and number of data services provided to the National Weather Service (NWS) and other customers. Fortunately, NOAA has been working on the foundational capabilities to enable programmatic tradeoffs which will be described in more detail below. In addition, the SATTF made several recommendations to NOAA for a fundamental realignment of NOAA's approach to satellites.

The SATTF advised the NOAA satellite service to be more discriminating about the observations that will be provided in the future and more agile in the ability to design, deploy and operate space-based systems. The SATTF encouraged NOAA to carefully consider alternative satellite architectural approaches, potentially using a larger number of smaller, more agile satellites that could be developed using lower cost practices and replaced quickly in the event of an early or on-orbit failure. The SATTF also expressed the need and potential of an enterprise ground system and noted that NESDIS had started efforts in that direction. Specifically, NOAA's satellite service is exploring possible reorganization and restructuring, placing an enhanced focus on establishing a total systems approach to satellite architecture development. For example, the satellite ground infrastructure is being examined to pursue migration to a more flexible, adaptable enterprise ground system. Although transitions require extensive planning and development, efforts such as these will enable enterprise-wide decisions that will contribute to overall system optimization.

The SATTF made eight specific recommendations which are summarized and discussed below.

Summary of SATTF Recommendations and NOAA's Response

Specific Recommendations from SATTF	Summary of NOAA's Response
1. Create, at the NOAA leadership level, a stable funding environment and management environment to support satellite activities	To improve the management environment, the DOC/NOAA chain of command oversight was streamlined, with standard

	metrics implemented. Top management monthly reviews focus on strategic issues, portfolio assessment and external engagement in order to support satellite projects.
2. Establish a prioritized list of threshold space-based observational requirements that maintains high impact capabilities. a) Define NOAA core functions and align them with national space policy and agency guidance b) Coordinate with all stakeholders (including national and international), with respect to prioritization of requirements and architectural tradeoffs c) Update the prioritization process database regularly with current information from subject matter experts	NOAA is continuing a significant effort to apply a “value tree” methodology to improve understanding of the impacts and value of all of NOAA’s observing systems and requirements to NOAA’s key mission areas. This analysis is being coordinated with the priorities of NOAA’s national and international stakeholders.
3. Create a Chief Systems Engineering function within NESDIS to address the end-to-end link from goals, to architectures, to concepts of operation, to individual system development and finally to delivery of the integrated systems across the organization	A Senior Systems Engineer has been retained and is advancing the recommended functions.
4. Develop a cost-capped implementation plan for a NOAA Enterprise Ground System building on the recently completed study and analysis of alternatives	NOAA continues a significant study for consolidating assets into an Enterprise Ground System capable of saving money and increasing flexibility and is establishing a senior leadership assignment with responsibility to lead the ground enterprise.
5. Develop an integrated master schedule addressing the entire satellite system architecture, including identification of the critical path(s)	Schedule management is a part of the new NESDIS Quality Management System, a comprehensive effort to elevate NESDIS-wide governance activities to better serve the mission of the organization. An integrated master schedule has been developed to show the key drivers impacting each satellite program.
6. Develop a tailored overarching risk-management plan consistent with alternative architectural decisions to ensure a sustainable future satellite program	NESDIS is developing a tailored risk management plan that assesses viable alternative satellite architectures and considers all levels of risk to ensure a sustainable future satellite program.

<p>7. Create a plan and a process for developing innovative and contingency options to mitigate gaps and potential reductions in capability and capacity</p> <ul style="list-style-type: none"> a) Establish a small, agile team to create the plan and process b) Capitalize on technology developments across all sectors, e.g., industry, academia, national labs and other agencies c) Consult other innovative organizations with space architecture experience; for example, DoD's Operationally Responsive Space (ORS) office provides one model for rapid response and lower capability alternatives, especially for observational reconstitution in the case of single instrument failures d) Balance Technology Readiness Levels (TRL) with the criticality of the measurements 	<p>NESDIS continues to explore a variety of approaches to mitigate the likelihood of a satellite gap and the operational impact should a gap occur. Of highest concern is the afternoon polar satellite (the JPSS system), which has been identified as a significant gap risk. A small team explored an array of mitigation alternatives and developed a comprehensive plan. Additionally, NESDIS continually monitors technical developments, considers commercial alternatives and collaborates with other innovative organizations, including the Operationally Responsive Space office. NESDIS also works with international partners to reduce risks and develop mitigations to potential and actual loss of observing capabilities.</p>
<p>8. ¹Given the ten year timeline required to develop new satellite systems conduct an analysis of alternatives, starting in FY2013, considering cost, performance, risk and resiliency, and assessing trade space vs. requirements for at least the following approaches:</p> <ul style="list-style-type: none"> a) Continue JPSS and GOES architecture, b) Pursue new multi-sensor satellites, c) Establish a hybrid of current polar and geostationary satellites, d) Investigate a federated architecture with defined missions for individual partners, and e) Develop a new distributed architecture. 	<p>Early trades have already occurred for the JPSS program regarding gap risk and cost. NESDIS' new systems engineering function will explore the suggested approaches and more undertaking analysis of alternatives for promising alternative satellite system architectures.</p>

¹ Bold text in original. This was identified by the SATTF as the central recommendation.

NOAA Response to Specific Recommendations**Recommendation One: Create, at the NOAA leadership level, a stable funding environment and management environment to support satellite activities.**

NOAA appreciates the SAB's recognition of the challenges inherent in managing extremely large and highly complex satellite systems. Over the past several years, NOAA has indeed experienced major funding and management challenges in the satellite programs. In response to these challenges and recommendations to simplify and stabilize the management environment, NOAA has implemented changes to our processes, procedures and documentation requirements.

In coordination with the Department of Commerce, NOAA has implemented significant changes in the satellite management culture. NOAA has restructured the executive review process for satellites to eliminate redundant reviews and focus top management attention on strategic issues, portfolio assessment and external engagement. Explicit definition of the roles, responsibilities, accountabilities and authorities were developed and documented reaching from the Secretary of Commerce level down to the NOAA Program Director. NOAA also updated standard satellite review metrics to match appropriate indicators of success with the corresponding executive decision level. To simplify reporting burdens, some formal reporting mechanisms were terminated (including the Program Oversight Board and the OMB Exhibit 300 documentation for satellite ground infrastructure). These restructured management processes are deployed and successfully functioning today.

Recommendation Two: Establish a prioritized list of threshold space-based observational requirements that maintains high impact capabilities.

- a) Define NOAA core functions and align them with national space policy and agency guidance**
- b) Coordinate with all stakeholders (including national and international), with respect to prioritization of requirements and architectural tradeoffs**
- c) Update the prioritization process database regularly with current information from subject matter experts**

NOAA concurs with this recommendation. Understanding and prioritizing NOAA's observing requirements will be critical to many of the activities being conducted in response to the other SAB SATTF recommendations.

To establish a prioritized list of observational requirements and better understand the impact and value of NOAA's observing portfolio, including space-based systems, the NOAA Observing System Council (NOSC) tasked its Observing System Committee (OSC), supported by the Technology, Planning, and Integration for Observations (TPIO) program, to complete the development of a NOAA-wide "value tree." This value tree will document NOAA's core functions, mission areas, key services, products and the inputs to each (e.g., observing systems). Once completed, this value tree will provide a foundation for assessing the value and impact of each component of NOAA's observing system portfolio as well as the relative priority of NOAA's observing requirements in order to assess trade-offs. The NOAA-wide value tree and the associated analysis are expected to be completed in late 2013.

In addition, NOAA is utilizing the White House Office of Science and Technology Policy (OSTP) led Earth Observation Assessment (EOA) to provide insight into national stakeholder priorities and architectural options. NOAA is analyzing the EOA dataset to map from the observing systems “scored” in that assessment to the environmental parameters they measure as a proxy for the observational requirements that are needed by our Federal partners. The EOA dataset will also provide insight into the value and impact of the non-NOAA observing assets to NOAA’s mission.

Lastly, NOAA will continue to work through various communities and forums to gain insight into the priorities of our international stakeholders and partners including but not limited to: the Group on Earth Observations (GEO), the World Meteorological Organization (WMO) and the Committee on Earth Observing Satellites (CEOS) with guidance from NESDIS.

Recommendation Three: Create a Chief Systems Engineering function within NESDIS to address the end-to-end link from goals, to architectures, to concepts of operation, to individual system development and finally to delivery of the integrated systems across the organization

NOAA/NESDIS has taken several steps to strengthen the satellite service’s ability to deliver for customers. NESDIS undertook a far more comprehensive review than considering only the addition of a Chief Systems Engineer. This included a renewed focus on core organizational priorities and the ability of the existing organizational structure to deliver on those priorities. This renewed focus led to a comprehensive top-down analysis leading to recommendations intended to strengthen NESDIS’s ability to deliver on mission priorities by establishing clarity in roles, accountability and authority. The analysis identified several new critical focus areas. These include: enterprise level systems engineering, enterprise ground system, environmental data systems and discrete projects and partnerships.

The analysis has been carefully studied and a reorganization concept has been shared with NOAA’s Workforce Management Office. Formal approval of the reorganization is expected to take several years, as the final decision rests with Congress. While not a new position, the Deputy Assistant Administrator for Systems (DAAS) was vacant, has been advertised, and is now in the hands of Dr. Thomas Burns.

NESDIS is proposing the creation of an organization to focus on systems architecture and advanced planning. NESDIS brought on board a highly qualified leader and systems engineering practitioner in December 2012 as an interim measure to lead the office team, while the reorganization evaluation continues and a permanent senior executive is hired for the position. This addition is already bringing an enterprise level systems engineering benefit to the major NESDIS acquisition programs. In December 2013, a new permanent Director, Systems Engineering will join the NESDIS Senior Executive team. Resource requirements for the office have been identified, and staffing has begun to fulfill needed functions using matrix assignments.

The Director, Systems Engineering is head of systems engineering, architecture and advanced planning. The responsibilities for this position include, but are not limited to: serving as the end-

to-end (from space sensors to delivery of data product) system architect for NESDIS, analyzing observational and data management requirements, allocating and validating the top-level requirements for assessment and implementation by the organizational divisions, supporting the budget strategy to meet NESDIS mission objectives, leading the technical evaluation of major systems acquisitions programs, and performing strategic planning, risk assessments, contingency planning, trade and technology assessments, and developing policy to ensure the health of operational and future capability.

Recommendation Four: Develop a cost-capped implementation plan for a NOAA Enterprise Ground System building on the recently completed study and analysis of alternatives

NOAA/NESDIS has taken several steps to strengthen the satellite service's ability to deliver for customers, focusing on core organizational priorities and the ability of the existing organizational structure to deliver on those priorities. The reorganization analysis identified several new critical focus areas, including a new enterprise ground system. Traditional NOAA ground system practice has had each major satellite mission designing and deploying a mission-optimized ground system, not an enterprise-optimized solution. When only two major systems (GOES and POES) comprised the NESDIS portfolio, this approach may have been optimal. Today, however, with disparate space-based observing systems from NOAA, NASA and international partners, the ground system function is an area ripe for review and promises significant gains for the organization.

Coincident with the SATTF review, NESDIS undertook an Enterprise Ground System (EGS) study. This study also pointed to the potential for significant cost savings in an EGS, leading NESDIS to engage in a number of focused implementation-oriented EGS studies. Each of these studies is expected to result in specific recommendations for implementation that are likely to have potential starting in FY2015 to show lifecycle cost savings/avoidance opportunities as a result of moving to more common ground functions (e.g., product ingest, product generation, product distribution, and archive). Cost savings means that budget requirements have the potential to be reduced for the required set of services. Cost avoidance means risk can be reduced, or cost to Government for specific functions can be reduced, but absolute declines in program budgets should not be expected as the future space-based architecture will likely require additional ground capabilities capable of supporting a distributed and more diverse space constellation.

NESDIS is proposing the creation of an office that focuses on Satellite Ground Services. This capability is being established in a matrix fashion. In the interim, NESDIS has assigned a highly qualified leader and data systems engineer to lead the team. This team would plan, acquire, develop, integrate, transition to operations and sustain common ground services for NOAA's environmental satellite systems. Acting as a single organization for planning and executing ground services, the team's functional responsibilities would include developing and sustaining command and data acquisition, communications, product generation and distribution, enterprise management, and data archive storage services for NOAA's environmental satellites. The team would also direct all metrics of common ground systems and provide engineering and project management services. The team would support budget formulation and cost estimation in coordination with other NESDIS Offices and manage budget execution for assigned products. In

December 2013, a new permanent Director, Satellite Ground Services will join the NESDIS Senior Executive team.

Important activities now underway are moving beyond the initial Enterprise Ground study toward establishing sensible, realistic and cost-managed transition plans that will result in greater cost effectiveness and efficiency. The results of these focused trade studies is being included in a larger ground architecture evaluation of the current implementation and on-going developments to support the existing missions and to enable a credible analysis of the improvements for the enterprise. The outcome of the ground architecture evaluation will enable NESDIS to develop a cost-capped implementation plan going forward in harmony with future developments and continued operations.

Recommendation Five: Develop an integrated master schedule addressing the entire satellite system architecture, including identification of the critical path(s)

An integrated master schedule has been developed that now forms part of the Quality Management Structure (QMS) being set up for NESDIS. The QMS is one of the Strengthening NESDIS initiatives. The integrated master schedule will include key deliverables and decision points for space and ground assets.

The NESDIS Satellite Portfolio contains a group of diverse satellites that form a loosely coupled program.² Each system has its own Integrated Master Schedule (IMS) which shows the key drivers impacting the individual program. Using these schedules, we are developing a timeline that will show the critical decision points for all satellites in the NESDIS portfolio. Such a master schedule will allow better management as it will identify potential bottle necks that result from a confluence of reviews or other major events between the different programs and projects. It will also readily identify time frames for block upgrades or replacement programs.

² NOAA's "loosely coupled" programs suggest a moderate degree of interdependence, interrelated objectives and the ability to achieve success with limited dependence on other programs. Programs can also be "tightly coupled" with a high degree of interdependence or "uncoupled" with no interrelationships.

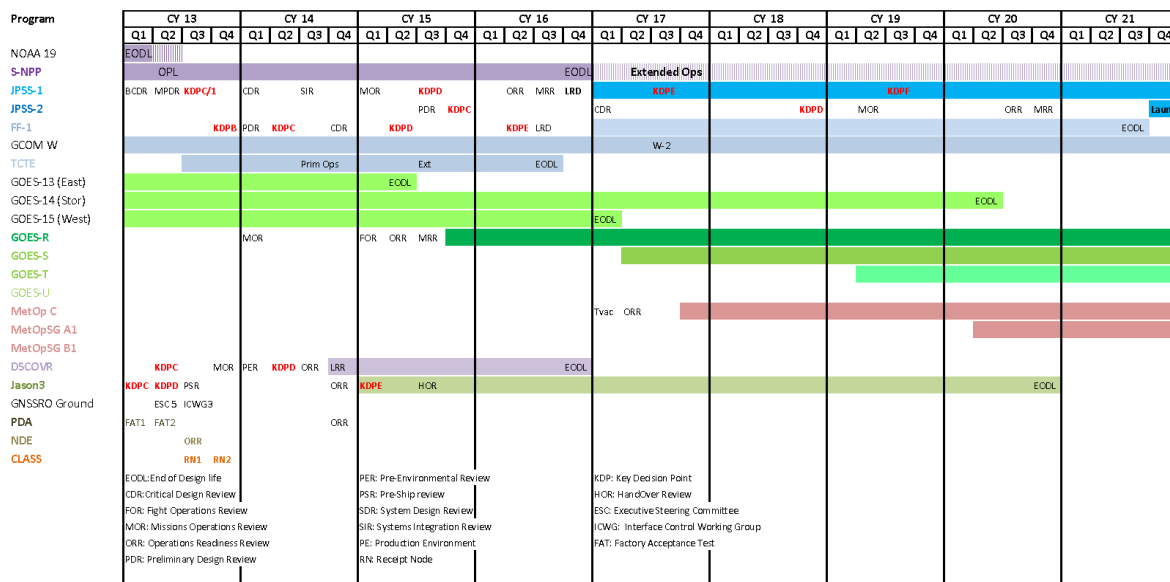


Figure 1: Notional NESDIS Master Schedule

The master schedule will enable NESDIS senior management to focus the entire organization to key development and operational priorities across the enterprise. Though the program is loosely coupled, the intersections of the family of systems, such as with enterprise ground resources, will be evident. The individual program IMS critical paths along with the enterprise intersections will be reviewed by the same senior management team at monthly status reviews to enable mitigation of conflicts and the ability to leverage the entire NESDIS organization on events critical for mission success. This timeline will be maintained by the Deputy Assistant Administrator for Systems (DAAS) and will be updated every six months or whenever a significant deviation occurs. Figure 1 depicts an early formulation of the NESDIS timeline tool.

Recommendation Six: Develop a tailored overarching risk-management plan consistent with alternative architectural decisions to ensure a sustainable future satellite program

NESDIS' new systems engineering team is leading the effort to define the framework and policy for a Risk Management Plan (RMP) for the NESDIS Enterprise. Effective risk management is critical to NESDIS' overall mission success which is to provide timely access to global environmental data from satellites and other sources. The NESDIS RMP will specifically be tailored to aid NESDIS senior management to assess, evaluate and decide on viable alternative satellite architectures which ultimately will ensure a sustainable future satellite program. The general intent of the RMP is to define the scope of risks to be tracked,³ methodology for managing and mitigating the risks, and means of documenting risks, including a tailored risk

³ A risk is defined as any threat to the NESDIS Enterprise or its performance objectives, including: program/project management; system design, acquisition, integration, verification and validation; operation of space-based assets; and data archival, algorithm development and product generation and distribution.

assessment matrix that examines and evaluates the likelihood of specific risks. The Director of Systems Engineering will lead the effort in drafting and maintaining the RMP.

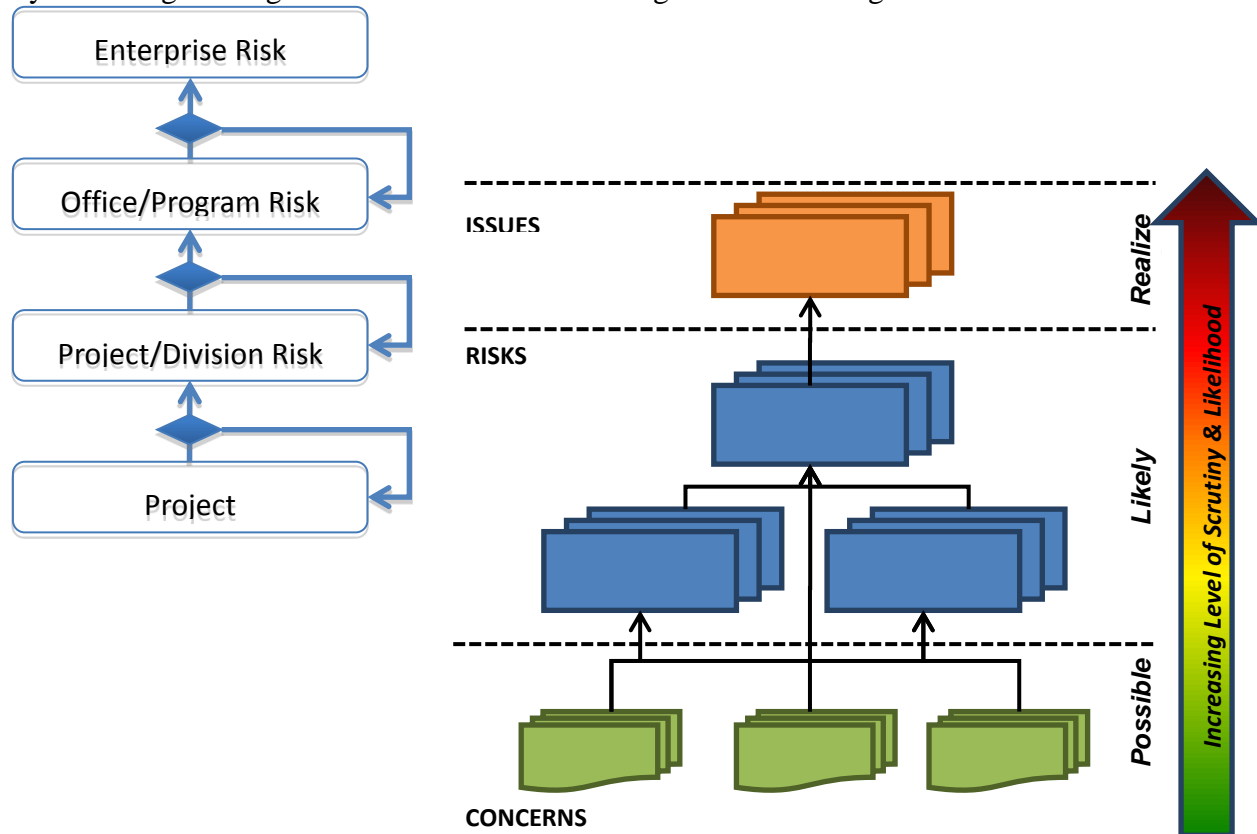


Figure 2: Notional representation of the hierarchy of the Risk Management

NESDIS is establishing a framework risk management procedure to be applied across all of the functions that entail the NESDIS Enterprise, and the organizations responsible for them managing risks at the level of each project all the way up to those that affect the entire Enterprise, as shown in Figure 2 above.

Recommendation Seven: Create a plan and a process for developing innovative and contingency options to mitigate gaps and potential reductions in capability and capacity

- a) *Establish a small, agile team to create the plan and process*
- b) *Capitalize on technology developments across all sectors, e.g., industry, academia, national labs and other agencies*
- c) *Consult other innovative organizations with space architecture experience; for example, DoD's Operationally Responsive Space (ORS) office provides one model for rapid response and lower capability alternatives, especially for observational reconstitution in the case of single instrument failures*
- d) *Balance Technology Readiness Levels (TRL) with the criticality of the measurements*

NESDIS is defining and establishing a process and providing the necessary resources to inform decisions for developing innovative and contingency options to mitigate gaps and potential

reductions in capability. This is closely coupled with the Risk Management process being implemented at the Enterprise level.

Recent specific activities to address the risk of gaps in products and services include:

1. A comprehensive independent study of options to mitigate a gap, should one occur, in critical afternoon polar-orbiting observations was completed with contracted expert support. Approximately 140 ideas were collected and evaluated from the study. High merit ideas were briefed to NOAA executives for action.
2. The “Sandy Supplemental”⁴ provided \$111 million for polar satellite gap mitigation, which is enabling NOAA to pursue the high merit recommendations from the independent gap mitigation study.
3. Since NOAA relies on the Department of Defense (DoD) for the early morning polar orbiting observatory, the recent decision to cancel the Defense Weather Satellite System (DWSS) increases risks to another polar orbit. Thus, our JPSS program remains in regular, close contact with USAF regarding their efforts in wake of DWSS termination. Liaison with DoD is effective as shown by the NESDIS AA’s quarterly dialog with the Air Force Space and Missile Center (SMC) Commander.
4. NOAA maintains comprehensive international connections to increase the option space to mitigate a variety of service gaps. These relationships include mutual assistance arrangements (e.g., for the Geostationary Satellites). We also engage in early mission planning and seek partnering opportunities. For example, NOAA is in dialog with the United States Air Force and the Canadian government for a possible Polar Communications and Weather mission (which could provide enhanced coverage of Alaska).
5. The JPSS Gap Mitigation Study, identified previously, looked at the near-term gap risk for polar-orbiting observation between the operations of SNPP and launch of JPSS J-1 and made a set of recommendations for NOAA to mitigate a gap in critical global temperature and water vapor profiles and imagery over Alaska. This effort was conducted via a small team of experts that were able to tap into the subject matter expertise and ideas across NOAA, other government agencies, academia and the public. The recommendations from this study have directly influenced funding priorities within NOAA and an action plan is now being implemented for mitigating a potential gap in critical polar data.
6. NESDIS continues a strong working relationship with NASA’s Jet Propulsion Laboratory (JPL) to assess the progress of new technological advances, such as the geostationary all-weather microwave sounder called Geo-STAR. Through NESDIS involvement, JPL’s

⁴ The Disaster Relief Appropriations Act of 2013, Public Law 113 - 2 - An act making supplemental appropriations for the fiscal year ending September 30, 2013 to improve and streamline disaster assistance for Hurricane Sandy, and for other purposes. In addition to the \$111 million for the gap mitigation reserve, NOAA received additional funding from the Sandy Supplemental for a variety of other disaster mitigation and recovery priorities.

Geo-STAR technology development will accommodate NOAA's operational requirements, as well as the primary science mission it supports.

7. A more recent development being tracked by NESDIS is the DoD's Hosted Payload Office, recently created to assess and promote cost-effective strategies to leverage commercial satellites for hosting U.S. government payloads.⁵ In its space architecture evaluations ongoing and continuing in FY 2014, NOAA will consider the use of a variety of approaches, such as buying data from commercially owned and operated space assets, making use of commercial launch vehicles and having instruments hosted on commercial satellites to meet its observational needs.

Recommendation Eight⁶: Given the ten year timeline required to develop new satellite systems conduct an analysis of alternatives, starting in FY2013, considering cost, performance, risk and resiliency, and assessing trade space vs. requirements for at least the following approaches:

- a) **Continue JPSS and GOES architecture,**
- b) **Pursue new multi-sensor satellites,**
- c) **Establish a hybrid of current polar and geostationary satellites,**
- d) **Investigate a federated architecture with defined missions for individual partners,**
and
- e) **Develop a new distributed architecture**

Recognizing the long timeline needed to develop new satellite systems, NESDIS has begun to evaluate future architectures for satellite systems and analyze alternatives. Cost, schedule, risk and resiliency are recognized as important considerations for the trades in addition to ensuring performance meets national objectives. As NESDIS fully evaluates its current architectural approach, an Analysis of Alternatives (AoA) will be performed that includes the approaches recognized by the SAB. It is anticipated that the resultant AoA will establish benchmark metrics for cost, schedule, performance and risk. The AoA process will combine effectiveness of an alternative with an integrated cost, schedule and risk approach restricted by available program funding. Figure 3, Notional AoA Process, is included for illustrative purposes to provide an overview of the NESDIS AoA process in early formulation.

One of the key roles of a future systems engineering capability will be to perform enterprise system architecture design, engineering and analysis to balance cost and schedule to meet NESDIS' mission, vision and objectives. NESDIS' 2013 priority has been appropriately placed on the JPSS architecture to address concerns with the risk of gap in the polar orbit observational coverage and respond to current national budgetary pressures. A refined and balanced approach to meeting the early weather forecasting and climate monitoring needs has been defined and is now in its early implementation within the JPSS Program.

⁵ NASA's first use of similar capability will take place when the recently awarded Tropospheric Emissions for Monitoring Pollution Observations (TEMPO) is launched later in this decade. TEMPO will be a government payload on a commercial geostationary communications satellite.

⁶ Bold font in original recommendation.

As the NESDIS reorganization concepts continue to be refined, the NESDIS capacity for broadly assessing architectural alternatives will become more mature and architectural trades will be a routine NESDIS activity. In addition to the five approaches recommended above by the SATTF, NESDIS' analysis of alternatives will consider commercial space capabilities and emerging new models for government and commercial engagements.

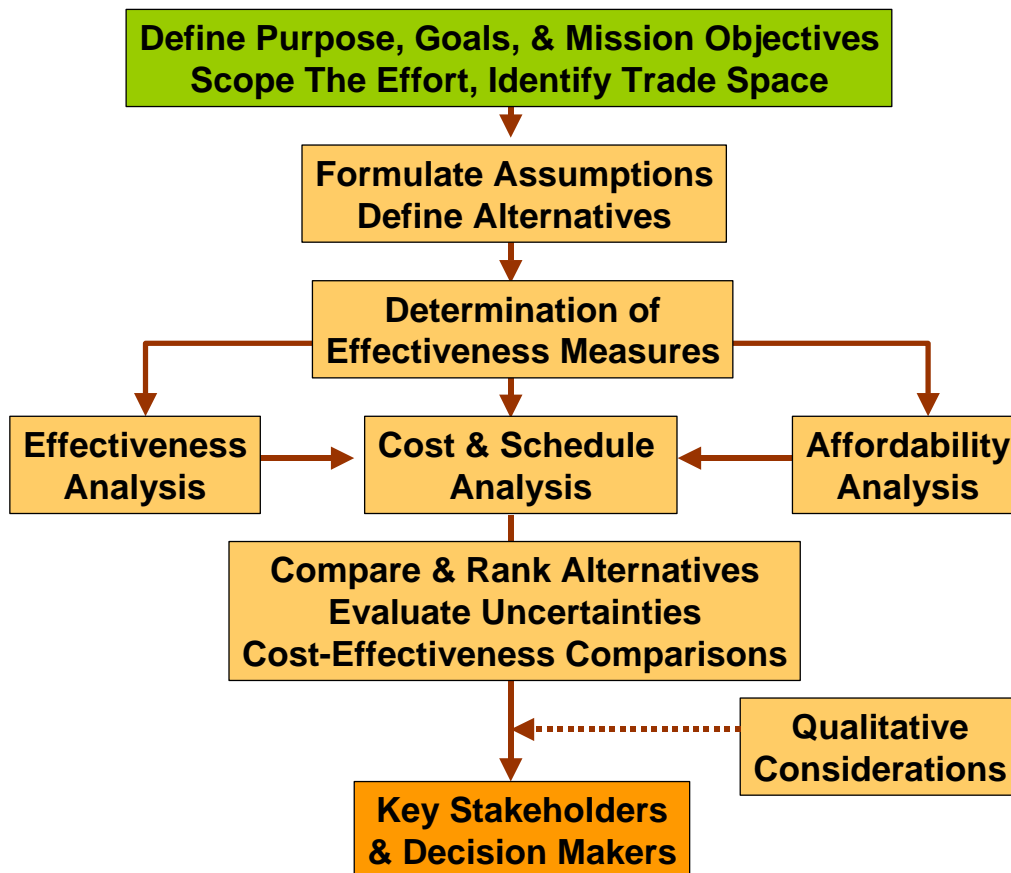


Figure 3: Notional AoA Process

Conclusion

NOAA greatly appreciates the dedicated service of the Science Advisory Board and the SAB's Satellite Task Force. The SATTF has identified a number of important avenues for strengthening NOAA's satellite future. The SATTF recommendations were received in the context of other NOAA reviews and reinforced those recommendations. NOAA looks forward to strengthening the satellite service to better serve the American public.